JCSP Agents-Based Service Discovery for Pervasive Computing

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Introduction

• Pervasive computing
• Smart space
  – Many autonomous devices
  – Dynamic network
  – Preferred model: no central control or repository
Introduction

Problem:

How to discover available devices/services in the network?

Proposed solution:

Send an agent around.
Agent

- Agent in Artificial Intelligence
- Mobile agent
- JCSP Agent
  - net2 protocol
JCSP Agent states

- **Passive state**:
  - Move agent to next destination
  - Process is activating agent
  - Agent indicating end of task
  - Agent performs some tasks

- **Active state**:
  - Move
  - Agent not needed
  - Suspend

- **Start**
  - Stop
How to discover other devices and their properties and services?
Device discovery mechanism

- *Discovery client* continuously sends a signal on a broadcast channel

- *Discovery server* continuously receives a signal and maintains its local list of available devices

- Every time the list if devices changes the *Main process* is informed
Service discovery mechanism

• Service discovery mechanism is triggered by new device in the network or when device changes its characteristics (for example change of interests of a device owner)

• Agent is sent to discover services and inform them about services offered by the new device

• Agent manages its own route of discovery based on a list of devices made by device discovery server

• Agent attaches to the device in its path and performs its assigned tasks, namely discover services

• Agent is a JCSP process
Message Room

Smart Space

Data:
IP: 134.27.221.10
Name: Alice
Preferences: Sport

Discovery:
Paul

Device 1

Data:
IP: 134.27.221.11
Name: Paul
Preferences: Art

Discovery:
Alice

Device 2
Message Room

Smart Space

Data:
IP: 134.27.221.10
Name: Alice
Preferences: Sport

Discovery: Paul

Data:
IP: 134.27.221.11
Name: Paul
Preferences: Art

Discovery: Alice

Data:
IP: 134.27.221.12
Name: Adam
Preferences: Art, Music

Discovery: 

Discovery: 

Device 1

Device 2

Device 3
Agent’s Discovery List:
134.27.221.10
134.27.221.11

Agent’s Home Address:
134.27.221.12

Data:
IP: 134.27.221.10
Name: Alice
Preferences: Sport

Discovery:
Paul

Data:
IP: 134.27.221.11
Name: Paul
Preferences: Art

Discovery:
Alice

Data:
IP: 134.27.221.12
Name: Adam
Preferences: Art, Music

Discovery:

Smart Space

Device 1

Device 2

Device 3

Agent
Agent’s Discovery List:
134.27.221.10
134.27.221.11
Agent’s Home Address:
134.27.221.12

Data:
IP: 134.27.221.10
Name: Alice
Preferences: Sport

Data:
IP: 134.27.221.11
Name: Paul
Preferences: Art

Data:
IP: 134.27.221.12
Name: Adam
Preferences: Art, Music

Agent (Step 1)

Discovery:
Paul

Discovery:
Alice

Discovery:
(Step 1)
Message Room

Agent’s Discovery List:

Agent’s Home Address:
134.27.221.12

Agent's Discovery List:

Data:
IP: 134.27.221.10
Name: Alice
Preferences: Sport

Discovery:
Paul
Adam

Data:
IP: 134.27.221.11
Name: Paul
Preferences: Art

Discovery:
Alice
Adam

Data:
IP: 134.27.221.12
Name: Adam
Preferences: Art, Music

Discovery:

Device 1

Device 2

Device 3

(Step 4)
Agent

Smart Space
Device 1
- Discovery: Paul, Adam
- Data: IP: 134.27.221.10
  - Name: Alice
  - Preferences: Sport

Device 2
- (Step 5)
- Data: IP: 134.27.221.11
  - Name: Paul
  - Preferences: Art

Device 3
- Data: IP: 134.27.221.12
  - Name: Adam
  - Preferences: Art, Music

Agent’s Discovery List:
- Discovery: Alice, Adam

Agent’s Home Address:
Message Room

Agent’s Discovery List:

Agent’s Home Address:

Smart Space

Device 1

Data:
IP: 134.27.221.10
Name: Alice
Preferences: Sport

Discovery:
Paul
Adam

Device 2

Data:
IP: 134.27.221.11
Name: Paul
Preferences: Art

Discovery:
Alice
Adam

Device 3

Data:
IP: 134.27.221.12
Name: Adam
Preferences: Art, Music

Discovery:
Alice
Paul

(Step 6)
Agent’s round trip results in:

Every device in the network is informed about services and properties of every other device once agent has gone around!
Experimental results

• The described scenario was built using PDAs (Dell Axim X5 with: Microsoft® Pocket PC OS, Intel® PXA255/400MHz, 64MB RAM, IBM J9 JVM )
• A network of 10 autonomous devices was implemented
• We confirmed dynamic configurability without any central control or repository
• Code size was 651 KB
Summary

- Service and device discovery in a smart space in pervasive computing is an issue
- We propose to use JCSP agents based system for service discovery
- We implemented scenario using mobile devices connected wirelessly
- A code size run on devices is 651 KB which is accepted for embedded devices
Future work

• Fixed size bag causing an early return to the home address
• Initiating multiple agents to discover large networks
• Dealing with agents that fail